



## Radiation Exposure on Earth



In this activity you will use the following worksheets to determine your average annual radiation dose here on Earth.

### Objectives:

- Explain the differences between geomagnetically trapped particles, galactic cosmic rays and solar particle events.
- Discuss the protection offered by Earth's atmosphere.
- Describe why a space weather forecast is important for people on Earth and in space.
- Determine your average annual radiation dose here on Earth.

### Research Question:

It is February 22, 2023 and you are deciding the best launch dates for the voyage to the Moon. Your recommendation is needed for the best timeframe to travel to avoid peak solar activity. Use the space weather forecast data to determine several options.

### Discussion Questions:

- What are some good examples of each source of cosmic radiation?
- How could you model the Earth's atmosphere to demonstrate its layers and thin nature?
- How have humans affected the atmosphere's ability to protect us from radiation?
- What spacecraft are important in forecasting of space weather?
- How can you reduce the amount of radiation you are exposed to?

### Materials:

Measuring Your Annual Radiation Dose worksheet

### References:

The primary source for this information is the Environmental Protection Agency and the American Nuclear Society's brochure *Personal Radiation Dose*.

The United States Nuclear Regulatory Commission  
<http://www.nrc.gov/what-we-do/radiation/affect.html>

The Environmental Protection Agency  
<http://epa.gov>

**Directions:** Place the value from the middle column that corresponds to your situation in the right column (Your Annual Dose). All values on this page are in milliSieverts (mSv). Add all of the numbers in the right column to determine your estimated annual radiation dose.

Factors	Common Sources of Radiation	Annual Dose
<b>Where you live</b>	<b>Cosmic Radiation (from outer space)</b> Exposure depends on your elevation (how much atmosphere is above you to block radiation). <b>Elevation</b> (average cities' data from the United States Geological Survey website: <a href="http://www.usgs.gov">http://www.usgs.gov</a> ) <b>Value (mSv)</b> <b>Sea level</b> (New York, Philadelphia, Houston, Baltimore, Boston, New Orleans, Jacksonville, Seattle) 0.26 <b>1-1000 feet</b> (Chicago, Detroit, San Diego, Dallas, Minneapolis, St. Louis, Indianapolis, San Francisco, Memphis, Washington, DC, Milwaukee, Cleveland, Columbus, Atlanta) 0.28 <b>1001-2000 feet</b> (Phoenix, Pittsburgh, San Jose, Oklahoma City) 0.31 <b>2001-3000 feet</b> (Las Vegas, Los Angeles, Honolulu, Tucson) 0.35 <b>3001-4000 feet</b> (El Paso) 0.41 <b>4001-5000 feet</b> (Salt Lake City) 0.47 <b>5001-6000 feet</b> (Denver, Albuquerque) 0.52 <b>6001-7000 feet</b> 0.66 <b>7001-8000 feet</b> 0.79 <b>8001-9000 feet</b> 0.96	_____ mSv
	<b>Terrestrial Radiation (from the ground)</b> <ul style="list-style-type: none"> <li>If you live in a state that borders the Gulf of Mexico or Atlantic Ocean, add 0.16 mSv.</li> <li>If you live in the Colorado Plateau area (around Denver), add 0.63 mSv.</li> <li>If you live anywhere else in the continental U.S., add 0.30 mSv.</li> </ul>	_____ mSv
	<b>House Construction</b> <ul style="list-style-type: none"> <li>If you live in a stone, adobe, brick, or concrete building, add 0.07 mSv.</li> </ul>	_____ mSv
	<b>Power Plants</b> <ul style="list-style-type: none"> <li>If you live within 50 miles of a nuclear power plant, add 0.0001 mSv. (For locations of nuclear power plants, visit the United States Nuclear Regulatory Commission website: <a href="http://www.nrc.gov/info-finder/reactor">http://www.nrc.gov/info-finder/reactor</a>)</li> <li>If you live within 50 miles of a coal-fired power plant, add 0.0003 mSv.</li> </ul>	_____ mSv
<b>Food Water Air</b>	<b>Internal Radiation (average values)</b> <ul style="list-style-type: none"> <li>From food (Carbon-14 and Potassium-40) and from water (radon dissolved in water)</li> <li>From air (radon)</li> </ul>	0.40 mSv 2.00 mSv
<b>Total (page 1)</b>	Add all the values for your annual radiation dose in the third column. Copy this number to the top line on the reverse side of this sheet.	_____ mSv
<b>Total (page 1)</b>	Transfer the total from the reverse side onto this line.	_____ mSv

Factors	Common Sources of Radiation	Annual Dose
<b>How You Live</b>	Weapons test fallout	_____ mSv
	Jet plane travel	_____ mSv
	If you have porcelain crowns or false teeth	_____ mSv
	If you wear a luminous wrist-watch	_____ mSv
	If you watch TV	_____ mSv
	If you use a computer screen	_____ mSv
	If you have a smoke detector	_____ mSv
	If you use a gas camping lantern	_____ mSv
	If you wear a plutonium-powered pacemaker	_____ mSv
	If you smoke	_____ mSv
<b>Medical Tests</b>	<b>Medical Diagnostic Tests (per procedure)</b>	
	Extremity x-ray (arm, hand, foot, or leg)	_____ mSv
	Dental x-ray	_____ mSv
	Chest x-ray	_____ mSv
	Pelvis/hip x-ray	_____ mSv
	Skull/neck x-ray	_____ mSv
	Barium enema	_____ mSv
	Upper GI x-ray	_____ mSv
	CAT Scan (head and body)	_____ mSv
<b>Total</b>	Nuclear Medicine (e.g. thyroid scan)	_____ mSv
	Add up all of the numbers in the third column to determine your annual radiation dose on Earth.	_____ mSv